



THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

Department of Physics

PHY 305 - Introduction to Use of Computers in Natural Resources

COURSE PARTICULARS

Course Code: PHY 518

Course Title: Atomic and Molecular Spectroscopy

No. of Units: 3

Course Duration: Two hour of theory and one hour of tutorial per week for 15 weeks.

Status: Compulsory

Course Email Address: odoalawaye@gmail.com

Course Webpage: <http://www.fwt.futa.edu.ng/courseschedule.php?coursecode=FWT%20204>

Prerequisite: PHY 401

COURSE INSTRUCTORS

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COURSE DESCRIPTION

This course introduces application of Quantum mechanics to selected phenomena in atomic and molecular physics. It covers the basis leading to the development and quantum mechanical equations for the interpretation of certain phenomena. It also covers spectroscopic experiments like x-ray scattering, Nuclear magnetic resonance (NMR) optical pumping and the Mossbauer effect.

COURSE OBJECTIVE

The objectives of this course are to:

- introduce students to applied modern physics
- provide students with opportunities to develop basic advanced physics skills necessary for solving real life quantum mechanical applied problems.

COURSE LEARNING OUTCOMES / COMPETENCIES

Upon successful completion of this course, the student will be able to:

(Knowledge based)

- understand the purpose and use of mathematical tools of quantum mechanics;
- understand the use of Identical Particles in quantum mechanics;
- understand the different scattering theory's and their applications;

(Skills)

- applying mathematical and physics skills to solve modern physics problems

GRADING SYSTEM FOR THE COURSE

This course will be graded as follows:

Class Attendance	5%
Assignments	5%
Test(s)	30%
<u>Final Examination</u>	<u>60%</u>
<u>TOTAL</u>	<u>100%</u>

GENERAL INSTRUCTIONS

Attendance: It is expected that every student will be in class for lectures and also participate in all practical exercises. Attendance records will be kept and used to determine each person's qualification to sit for the final examination. In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with any of the instructors, indicating the reason for the absence.

Academic Integrity: Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are prohibited. You are not allowed to make copies of another person's work and submit it as your own; that is plagiarism. All cases of academic dishonesty will be reported to the University Management for appropriate sanctions in accordance with the guidelines for handling students' misconduct as spelt out in the Students' Handbook.

Assignments and Group Work: Students are expected to submit assignments as scheduled. Failure to submit an assignment as at when due will earn you zero for that assignment. Only under extenuating circumstances, for which a student has notified any of the instructors in advance, will late submission of assignments be permitted.

Code of Conduct in Lecture Rooms and Laboratories: Students should turn off their cell phones during lectures. Students are prohibited from engaging in other activities (such as texting, watching videos, etc.) during lectures. Food and drinks are not permitted in the laboratories.

READING LIST

¹ Nouredine Zettili (2009). *Quantum Mechanics Concepts and Applications*. Second Edition. John Wiley and Sons, Ltd., Publication, USA. 692p.

¹ Alastair I. M. Rae (2002). *Quantum Mechanics*. Fourth Edition, IOP Publishing Ltd, UK 295p.

² David K Ferry (2001). *Quantum Mechanics An Introduction for Device Physicists and Electrical Engineers*. Second Edition. IOP Publishing Ltd. 295p, UK. 355p.

Legend

1- Available in the University Library

2- Available as Personal Collection

COURSE OUTLINE

Week	Topic	Remarks
1	Atomic Transitions and Spectroscopy <ul style="list-style-type: none"> • Rutherford Planetary Model of the Atom • Bohr Model of the Hydrogen Atom • The energy of the elliptical orbit 	During this first class, the expectation of the students from the course will also be documented.
2 & 3	Relativistic corrections and its effects	Tutorial session will be introduced.
4 & 5	Electron spin and vector model of the atom <ul style="list-style-type: none"> • Central Field Approximation • Spin Orbit Coupling 	
6	Identical particles and symmetry <ul style="list-style-type: none"> • Many-Particle Systems • Systems of Identical Particles • The Pauli Exclusion Principle • The Exclusion Principle and the Periodic Table 	
7 & 8	The diatomic molecule <ul style="list-style-type: none"> • Hyperfine structures • Zeeman effect 	MID-SEMESTER TEST
9 & 10	X-ray diffraction <ul style="list-style-type: none"> • Theoretical Considerations • Basics of Crystallography • Production of X-rays • Applications of XRD 	

11 & 12	Scattering theory <ul style="list-style-type: none"> • Compton effect • Reflection refraction and polarization of electromagnetic waves • Microwave methods 	
13 & 14	Resonance phenomenon <ul style="list-style-type: none"> • Nuclear magnetic resonance • Optical pumping 	
15	REVISION	This is the week preceding the final examination. At this time, evaluation will be done to assess how far the students' expectations for the course have been met.